

cent. on two inches, correlated, however, with a maximum stress of only 19·2 tons per sq. in.

A long series of observations revealed the curious fact that no correlation exists between the densities and mechanical properties of steel castings.

The mechanical influence of annealing at 950° C. and slowly cooling from that temperature is, in the case of iron containing about 0·4 per cent. of carbon, exemplified by the following figures:—

Condition of steel	Elastic limit tons per sq. in.	Max. stress tons per sq. in.	Elongation per cent. on 2 in.	Reduction of area per cent.
As cast...	17·22	23·41	6·5	8·4
After annealing..	10·08	24·03	24·5	29·0

The micrographic effect of drastic annealing is shown in the drawing, CC2, which has been reduced from a 6-inch circle magnified 315 diameters.

The constituents of the steel as cast present an irregular trellis-like pattern of pale ferrite or iron and dark pearlite or steel. In addition, small castings, or small parts of large castings, present curious brown-etching lines of a sulphur alloy,

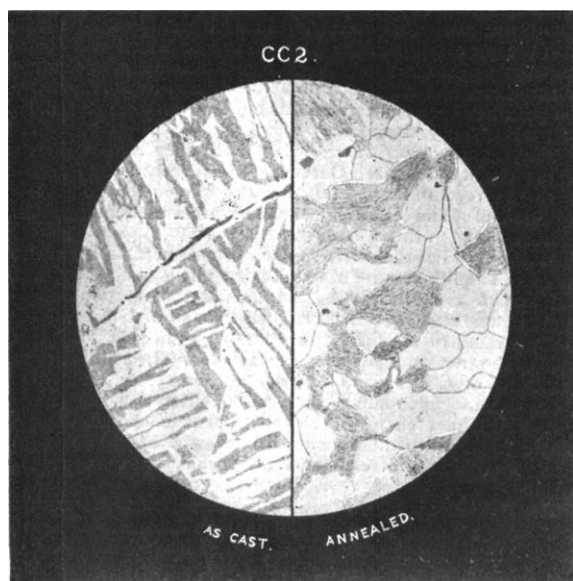


FIG. 1.—Casting CC2. (Reduced from six-inch circle, magnified 315 diameters.)

which arrange themselves almost exclusively along the ferrite, forming lines of dangerous weakness.

After annealing, the long lines of cleavage between the constituents are broken up, large patches of laminated pearlite and allotrimorphic crystals of iron being formed. At the same time, the dangerous lines of the attenuated sulphur alloy are destroyed, segregating into isolated patches. All the above features are well indicated in the micrograph figured. Steel castings often present mechanical discrepancies very difficult to explain, e.g. elongations per cent. and bending angles form measures of ductility which might be expected to be proportional to each other, but often such is not the case.

A remarkable feature of the results recorded is the fact that some of the castings built up of very large crystals have presented great ductility, whilst castings with that minutely crystalline structure usually supposed to give the best mechanical results have given unsatisfactory tests.

Considering the fact that such castings were of identical chemical composition and had been subjected to similar thermal treatment, it is difficult to avoid the conclusion that the initial temperature of the steel on casting may exert a permanent mechanical influence, and that consequently the operation of annealing is not thoroughly effective.

## SCIENTIFIC WORK IN EGYPT.

SEVERAL matters of scientific interest are described in Lord Cromer's report upon the finances, administration and condition of Egypt and the Soudan. Particular attention is directed to Sir William Garstin's memorandum on irrigation, and to the value of the work of hydraulic engineers in Egypt. Sir William Garstin brings forward observations showing a continuous fall of level of Lake Victoria Nyanza. His remarks upon this fall and the rainfall observations available are here reprinted.

*"Lake Victoria Nyanza Rain Gauges.*—Information regarding the daily rainfall and the lake levels is now regularly received in Egypt from Uganda. The first series of registers, previous to the rebellion, dates from June 1, 1896, to July 31, 1897. The second series commences on September 1, 1898, and has been carried on to October 31, 1900. Unfortunately, it is impossible to connect the two series, as the gauges erected subsequent to the rebellion are not the same as those which formerly existed. We have, therefore, only twenty-six months of observations upon which to base possible theories. This is not sufficient, more especially as we are still ignorant of many important factors bearing upon the relations of the levels and rainfall of the equatorial lakes with the Nile supply. Information regarding the most important point of all, viz. the Albert Nyanza Lake, is still entirely wanting. This is much to be regretted, as this lake, which drains an enormous catchment area, and through the northern end of which passes the water coming from the Victoria Lake, is probably the most important of the reservoirs which feed the White Nile. It is to be hoped that early measures may be taken to erect gauges upon the Albert Lake and to observe them regularly. The records thus obtained would be invaluable to Egypt.

"The following facts, elicited from the rather meagre information at our disposal, may perhaps be of general interest:—

"Two observing stations now exist on the Victoria Lake, one on either side, viz. at Port Alice or Entebbe and at Port Victoria or Ugowe. Unfortunately, the rainfall register for Entebbe only commences from the month of April 1900, so a comparison between the two for the whole year is impossible.

"The Ugowe rain gauge record shows that 46·28 inches of rain fell in the twelve months ending with October 1900, that there were 131 rainy days, and that the storms invariably took place either in the afternoon or at night. Further, that February was the wettest month of the year and July the driest, 6·45 inches being registered for the former and 1·56 inches for the latter. It would also appear that the period of the heaviest rainfall is from November to May. The total rainfall for the six months in question was 30·73 inches, the remaining six months being responsible for only 15·55 inches.

"The rainfall at Entebbe, on the opposite side of the lake, was, so far as the records go, considerably heavier than at Ugowe. The total fall between April and November 1900 was 30·39 inches at the former place, as against 20·59 inches at the latter. As regards the rise and fall of the water surface of the lake it is possible to make a comparison, as registers have been supplied regularly from both stations. . . .

"The records, as far as they go, seem to prove that the lake is always at its lowest in October, i.e. at the end of the dry season, and at its highest in December or January. They also show that the lake level has been steadily falling for the last three years, thus:—

	Port Alice (Entebbe).	Port Victoria (Ugowe).
	Ft. in.	Ft. in.
Lake levels on October 1, 1898	3 2	3 2½
" " 1899	2 6½	2 2
" " 1900	1 7	1 1

"It is possible that this fall in the levels may be, in some measure, due to degradation of the bed of the river in the channel whence it issues from the lake; but it seems to be far more probable that it has been caused by a failure of the rainfall over an immense area. All reports go to show, and all travellers who have visited these regions relate, that a severe drought has prevailed over a large portion of Central Africa during the last two years. This drought has extended as far north as the Egyptian Soudan.

"Although it may seem likely that the Nile flood of 1901 will be a poor one if these figures are correct, it would be misleading to attempt to draw any definite conclusions from them. The

register of the rainfall only dates from a very recent period, and consequently no comparison can be made with the fall of previous years. Again, the available knowledge of the many factors, which together combine to produce the annual rise of the White Nile, is at present extremely scanty.

"Lastly, as has been already stated, the Albert Nyanza Lake must exercise a most important influence upon the volume of the river, but no attempt has as yet been made to collect information regarding it. It is most desirable that a regular register of its levels and its rainfall should be commenced and maintained as soon as possible."

*The Sudd in the Bahr-el-Gebel.*—Major Peake's sudd-cutting party removed, in all, fourteen blocks of sudd during 1900. Some of these blocks were, in places, a mile in length and from 15 to 20 feet in thickness. The surface of the river channel was completely closed, and the stream passed underneath the sudd with a high velocity. Sir William Garstin remarks that a visit to the work changed many preconceived ideas as the nature of the obstruction. Instead of the sudd being, as had been supposed, a tangle of weed floating on the water and descending a few feet below the surface, it proved, in most cases, to be a mass of decayed vegetation, papyrus roots and earth, much resembling peat in its consistency, and compressed into such solidity by the force of the current that men could walk over it everywhere, and even elephants could, in places, cross it without danger. The most effectual method of removing it was found to be by cutting deep trenches on the surface, thus dividing it into rectangular blocks of some 10 feet square. These were hauled out, block by block, by means of chains and wire hawsers attached to the gun-boats.

Two portions of the Bahr-el-Gebel still remain uncleared. The one commences at 140 miles south of Lake No, and is some 25 miles in length. The other is some 52 miles further south and about three miles long. In both instances the true channel of the river is blocked by sudd, and it now follows a false channel; in the former instance it passes through a series of broad, shallow lakes.

*Survey of the Cataract Region.*—Lord Cromer states that the construction of the Nile Reservoirs is now so far advanced that the time has arrived when further studies of the river may usefully be made, so that, should it eventually be found necessary to still further augment the water supply of Egypt, the requisite information for the preparation of the project, or projects, shall be at the disposal of the Ministry of Public Works. One of the first steps necessary to attain this end is to make an accurate survey of the Nile Valley where it passes through the cataract region south of Wady Halfa. It may eventually be decided that a second reservoir is not the best means of supplementing the summer volume of the river, but that it will be more advisable to obtain it by regulating the outlets of the Equatorial and Abyssinian Lakes, by opening up the Bahr-el-Gebel, or some other large scheme. Until, however, a thorough knowledge of the river, as a whole, has been obtained, it would be premature and unadvisable to take any decision whatsoever. The present work is a commencement in this direction, and even should the results obtained, as regards the construction of another dam, prove to be negative, the information thus acquired will be invaluable to those charged with the control of the river.

It is proposed, therefore, to survey the cataract region, at the same time running lines of levels up the river valley. A geological surveyor will accompany the party. It is calculated that three years' work will be required to complete it as far south as the head of the third cataract.

*Meteorological Department.*—The Observatory, situated in the Abbassieh quarter of Cairo, was greatly improved during the course of last year. The equipment of a first-class meteorological observatory is now working there regularly. The time-ball at Port Said is dropped daily at noon by a current, working automatically, which is sent from the Observatory. Those at Cairo and Alexandria were to commence working early this year. The time of the 30° meridian east of Greenwich has been made civil time for the whole of Egypt, replacing the various local times previously in use.

Eight stations between Alexandria and Omdurman now take regular meteorological observations and send telegraphic weather reports to Cairo daily at 8 a.m. These are printed and published. Arrangements have recently been made by which similar telegraphic reports are daily exchanged at 8 a.m.

between Alexandria, Malta, Brindisi, Trieste and Athens. These telegrams are posted for general information at the ports of Alexandria and Port Said.

The observations of all meteorological stations are printed and published monthly. The complete results of the work at the Central Observatory will be published shortly. The observations registered in 1899, together with the mean values of the preceding thirty years, are already printed and ready for publication.

Besides Omdurman, where there is a complete set of instruments, the stations of Rosaires, Fashoda, Wad Medani and Kassala now record rainy days and approximate fall. They have not yet been furnished with proper rain gauges. It is hoped that before long observing meteorological stations may be instituted at different points on the Blue and White Niles.

Funds have been granted for transferring the Central Observatory to Helouan, fifteen miles south of Cairo. The new building will be commenced this year. A set of thermometers has been sent to the base camp at Meshra-er-Rek, in the Bahr-el-Ghazal Province, to be registered and observed there daily.

*Geological Survey.*—The staff of the Geological Survey has been employed in compiling the results of the previous three years' field work. Reports on the oases of Kharga, Dakhleh and Farafra are on the point of being published; five other reports are ready for printing. Good progress has been made with the preparation of the maps, some of which will shortly be ready for publication. A geological museum is in course of construction, and will probably be completed before the end of the year. The expenditure on this building up to the end of last year was about £E. 2700.

*The Preservation of Game.*—Captain Stanley Flower, director of the Gizeh Zoological Gardens, is frequently asked questions as to the regulations existing for the preservation of game in the Soudan. The following statement from the report supplies information upon these matters.

A system of licenses for non-native sportsmen has been introduced. The licenses are of two kinds: one is issued at £E. 25 and known as licence "A," authorising the shooting of every kind of game except a small class which is absolutely protected, the other issued at £E. 5 and known as licence "B," from which the rarer kinds of game are excluded. In addition to the licence fee of £E. 25, the holder of a licence "A" is required to pay a fee for each animal included in Class 2 which he may kill. A higher charge is made for female animals, but no female animal of the kind included in Class 2 may be knowingly shot. In the case of elephants the royalty upon ivory is also payable.

The Wild Animals Preservation Ordinance, 1900, also provided that natives might be requested to take out licences, but this provision only applies in districts where it is specially brought into force by a notice issued by the Governor-General. The terms of the licences are arranged by the licensing officer. This part of the Act has been brought into force as regards Kassala, and licences have been granted to the Sheikhs of two or three tribes to kill or capture a limited number of the bigger kinds of game. They pay nothing for their licence, but are required to inform the Mudir if they kill or capture any elephant, giraffe, buffalo or certain other kinds of game and to pay a fee varying from £E. 1 to £E. 8; as there is usually a demand at Kassala for specimens of wild animals, it is thought that the natives will readily pay the fees.

Several specimens of wild animals have been exported during the year, and there is also a certain traffic in skins and trophies. There was reason to fear that, unless the trade was controlled, it would lead to unnecessary destruction of the rarer sorts of animals. The Wild Animals Preservation Ordinance, 1901, which has been recently promulgated, places the export of wild animals and birds under Government control.

Section 2 prohibits the export of wild animals and birds, or of their skins, feathers, horns and trophies in an unmanufactured condition other than elephants' tusks, rhinoceros horn and ostrich feathers, except under Government permit. The provision does not apply to animals or birds which are killed under a game licence.

The Governor-General is empowered to permit the export of animals and birds of which there is no reason to fear the destruction and to impose a tax upon the same. Arrangements have been made to establish a special department of the Govern-



ment under the general superintendence of Captain Flower, the Director of the Gizeh Zoological Gardens, to deal with questions relating to the wild animals and birds of the Soudan. Licences to export live specimens will be issued by this Department at fees to be determined later, and the Department will undertake the supply of specimens to Zoological Gardens, Museums and others.

*Zoological Gardens.*—Special attention has been paid to the fauna of the Nile Valley. There were in the Gardens in October last 670 animals, representing 169 species, as compared with 473 animals, of 132 species, at the corresponding date in 1898. The most important acquisitions have been a giraffe, presented by Lord Kitchener, and a white oryx, from Kordofan, presented by Sir Reginald Wingate.

The staff of the Gardens was mainly employed during the year in rebuilding and repairing cages. An elephant-house has been built, and plans are being prepared for a new lion-house.

*Nile Fish Survey.*—The collecting of fish was, during the early part of the year, extended as far as Abu Hamed, and at present Mr. Loat, the specialist selected by the authorities of the British Museum, is working on the White Nile. A considerable number of plates, which will eventually be published, have been printed, and material from which others may be drawn has been obtained. A severe loss was sustained last year in the death of Dr. John Anderson, F.R.S., whose knowledge and experience made his advice of the greatest value in carrying out a work which was taken in hand owing to his initiative.

*Egyptology.*—Under the very capable direction of M. Maspero, a great improvement has recently taken place in the working of all branches of the Archæological Department. Notably, the appointment of two English inspectors-in-chief has done much to preserve the monuments, both in Lower and Upper Egypt, from further depredation and mutilation.

Work has been proceeding at Karnak. It will be remembered that eleven columns in the Great Hall fell to the ground during the flood of 1899. Five further columns appeared to be in some danger of falling. Under the direction of MM. Legrain and Ehrlich, these columns have now been dismantled; others have been strengthened and repaired. The *débbris* of the stones which had fallen has been removed, labelled and arranged in such a manner as to render it possible, should it ever be decided to rebuild these columns, to replace each separate stone in the precise position which it formerly occupied.

Lord Cromer says he has been informed, on high technical authority, that, in spite of every precaution, the remaining portions of this splendid monument of antiquity will of necessity be exposed to considerable risk every year at the period when the subsoil water is falling. A very heavy expenditure of money would, without doubt, minimise this risk, but it is doubtful whether, under any conditions, it will be possible to obviate it completely.

The bases of the columns are of insufficient strength; the soil is unstable; each column supports an immense weight in the shape of roofing-blocks; and the whole structure has been erected without mortar and without bond of any sort.

The principal tombs at Thebes have been closed by gates. The tomb of Amenophis II. has been so arranged that the Royal mummy remains *in situ*, and can be seen by visitors. M. Maspero is studying a project for lighting these tombs by electricity, so as to obviate the destruction to the wall paintings caused by the candles used by visitors.

*Technical Education.*—The only important technical school in Egypt is that situated in the Boulac quarter of Cairo. The School of Agriculture is a very popular institution, and is rendering good service to the country, but more institutions of this kind seem to be needed.

Lord Cromer refers particularly to the educational needs of Egypt, and suggests that attention should be given to technical education in all its branches. He has discussed this subject with various authorities in Egypt, and finds a general disposition to do something towards the improvement and extension of technical instruction. Mr. J. Currie, director of education in the Soudan and Principal of the Gordon College, has reported upon the subject, and extracts from his report are given by Lord Cromer. It is proposed to establish a large industrial school at Khartoum, to be worked in connection with the Government dockyards and workshops. It is also proposed to find house-room for, and supervise, the following institutions at Gordon College, so far as that can be possible: (a) A general Soudan reference library; (b) an economic museum, to assist in the com-

mercial development of the country; (c) a meteorological station and a small observatory; (d) a small analytical laboratory.

### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MISS E. S. BARCLAY has bequeathed to Bedford College the sum of 1000*l.* without conditions.

WE learn from *Science* that Pittsburg will probably soon have a great technical institution, especially adapted to its needs and as complete in the industrial field of education as the Carnegie Institute of that city has become in art and æsthetics. An advisory committee appointed to determine the best plan and most suitable scope of the new institution has just presented its report to Mr. Carnegie. These expert advisers were Dr. R. H. Thurston, Director of Sibley College, Cornell University, Prof. J. B. Johnson, Dean of the College of Engineering, University of Wisconsin, Prof. Thomas Gray, of the Rose Polytechnic School, and Prof. V. C. Alderson, of the Armour Institute. The scheme proposed includes three different and distinct forms of school which may be combined as parts of one complete technical university. If the whole scheme is accepted by Mr. Carnegie, there will be, in the first place, a first-class technical college. "This college," says the committee, "should be made attractive to the greatest scholars in the fields of physical and chemical science. To obtain and hold such men they must be given ample opportunities for research. This college must be supplied, therefore, not only with great experimental shops and laboratories for students' use, but in all departments there should be splendidly equipped laboratories of investigation and research, under the direction of the head of such department, and with a full corps of assistants for the carrying on of all lines of investigation which are now partly or wholly unprovided for in America." There will also be a Technical High School to carry on work above that of the public grammar school, and day and evening classes for the benefit of those who are unable to take advantage of the more complete courses in this school. Mr. Carnegie has now to decide whether he will found a school for artisans, a technical high school or a technical college, or, if his ambition mounts so high, a true technical university including them all.

AN article by Mr. J. B. C. Kershaw in the July number of the *Monthly Review* contains a few facts which should be of interest to all who are concerned with educational and national progress. He points out that technical education as at present carried on in this country is chiefly instrumental in giving to great numbers of young people elementary instruction in every subject except the dead languages. In the opinion of practical men, this smattering of science and other subjects is of no value from an industrial point of view, and as a system for bringing the few who possess undoubted ability or genius to the front it is costly and unnecessary. In England the aim has been to educate the rank and file of the workers, but the German aim is to educate thoroughly all who are to occupy posts of authority in manufactures and industries. Herein there is a great difference, and many people are beginning to see that the German method is the best when industrial progress is taken as the criterion. The reason lies in the ability to appreciate new developments, or, as Mr. Kershaw puts it, "a thorough scientific training enables the manufacturer to decide quickly upon the merits of the new processes or inventions, and he is not daunted by the fact that in this newly-chosen path of industrial progress there is no 'practical experience' to guide his steps. The German manufacturer has, therefore, been assisted by his own thorough technical training, and by that of his manager, engineer or chemist, in adapting himself more quickly than his English rival to new conditions of trade, or to the exigencies of new processes and new developments of industry." There is little hope of substantial improvement while our manufacturers and commercial men, as a rule, have so little sympathy with scientific work. Their general attitude is reflected in advertisements of this kind—"Wanted, young man as Chemist at Tar and Vitriol Works in North of England; willing to fill up time at Bookkeeping." While trained chemists are considered to be on about the same level as a clerk and inferior to a skilled operative, how can we expect to make advances similar to those which Germany and the United States are making?